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15 February 1976

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THEMATIC MAPPING, LAND USE, GEOLOGICAL
STRUCTURE AND WATER RESOURCES
IN CENTRAL SPAIN

Project no. 28760

FIRST QUARTERLY REPORT

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THEMATIC MAPPING, LAND USE, GEOLOGICAL STRUCTURE AND WATER
RESOURCES IN CENTRAL SPAIN.

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I. INTRODUCTION

The multidisciplinary project no.28760: "Thematic Mapping, Land Use, Geological Structure and Water Resources in Central Spain" has been started, upon receipt of the first images obtained by LANDSAT-2 satellite submitted by NASA. Several equipments have been purchased and working techniques been developed for this investigation.

This project involves the participation of several organizations and working groups related to the problem of surveying the earth surface for their own scientific fields. Instituto Geográfico y Catastral is the agency that holds the coordinative function in this multidisplinary project. Participant organization are the following:

Departamento de Geografía de la Universidad de Madrid.

Centro de Estudios Hidrográficos.

Instituto Geológico y Minero.

Cátedra de Geodinámica Interna de la Universidad de Madrid.

Cátedra de Botánica de la Universidad de Madrid.

Departamento de Suelos del Instituto de Edafología

Area Metropolitana de Madrid

Centro de Investigación UAM-IBM de la Universidad Autónoma de Madrid.

All these working groups have been provided with copies of LANDSAT-2 images during the last month of January.

II. TECHNIQUES

Products received from NASA through the EROS Data Center are the following:

- black and white negatives in 70 mm film, all four bands MSS, scale 1:3.369.000
- black and white paper prints, all four bands MSS, scale 1:1.000.000.

Until the moment, reproduction work has been finished in order to provide to all participant organizations with the following product:

- black and white paper print enlargements, all four bands MSS, at scale 1:500.000.

At the same time, black and white contact positives on 70 mm film have been obtained from each original negative. This positive product is been used for two purposes:

- as input working document for the color composite viewer, which shows false color images enlarged at scale 1:500.000 on horizontal screen.
- as input working document for photographic processing of false color images, at scale 1:500.000, using Cibachrome positive material. This product has not yet been obtained but it is hoped to attend good results in the next few weeks. Instituto Geográfico y Catastral will use this technique for obtention of false color images, by means of a DURST color enlarger.

Contact reproductions on 70 mm film, from negative to positive, showed problems because the critical density requirement, in the gray level scale, of the additive color composite

Viewer. Original negatives had a maximum density of 1.82, which had to be reduced in the contact positive to 1.62 (0.2 units lower). Reproduction was done on Agfa Gevarex G0 21P film.

γ values were obtained, in the straight part of the relative logE curve, for each developing time. Densitometric measurements were made with a Densichron Welch equipment.

Black and white enlargements did not show good half tones on Kodak Kodagraph paper first used when work started, and a new product was tested: Agfa Copyline Projection P150 WP paper. This paper has a higher sensitivity and processing was done automatically on a PAKO film processor.

Instituto Geográfico y Catastral has recently installed in Madrid a Remote Sensing Laboratory for development of this project and other national programs on remote sensing. The Laboratory has photointerpretation facilities, access to several computers for digital processing of CCT'S, color photographic laboratory, field test equipments for acquisition of ground truth and library. Equipments available are shown on tables no.1 to 5 with explanation of their functions. The objective of this laboratory is to carry out studies on radiation of earth materials and their relationship to data collected from aircrafts and spacecrats. Processing of LANDSAT data supplied by NASA for this project will represent the main activity of the laboratory during the year 1976.

Digital processing of NASA CCT's is been done by the IBM Scientific Center, of the Autonomous University of Madrid, as participant on this project. The Center has operational an IBM 370/145 computer with ERIPS program and an interactive television terminal RAMTEK. Two CCT's have been requested to EROS Data Center for analyses through ERIPS program. They

EQUIPMENTS	IGC REMOTE SENSING LABORATORY/PHOTOINTERPRETATION FACILITY							
	INPUT				OUTPUT			
	PRODUCT	IMAGE	FORMAT	SCALE	PRODUCT	FORMAT	IMAGE	SCALE
LIGHT TABLES	ROLL FILM	COLOR (+) COLOR (-) B & W (+) B & W (-)	FROM 35 mm TO 9½"	LANDSAT MAXIMUM 1:1.000000	SAME AS INPUT	SAME AS INPUT	SAME AS INPUT	SAME AS INPUT
	CUT FILM	IR B&W IR COLOR		AERIAL ANY				
ADDITIVE COLOR COMPOSITE VIEWER	ROLL FILM	POSITIVE B & W	70 mm	LANDSAT 1:3369.000	HORIZONTAL SCREEN PROJECTION	B&W COLOR IR B&W IR COLOR	20"x20"	LANDSAT 1:500.000
	CUT FILM			AERIAL ANY				AERIAL 6'74 x ENLARGEMENT

Table 1.

HARDWARE	IGC REMOTE SENSING LABORATORY/COMPUTER FACILITY					
	INPUT		SOFTWARE	OUTPUT		
	PRODUCT	FORMAT		PRODUCT	FORMAT	IMAGE
FILM RECORDER INTERFACED TO PDP 11/45 COMPUTER	LANDSAT CCT REFORMATED	9 TRACK	DICOMED	CUT FILM 4"x5"	70 mm	COLOR (+)
	AERIAL MSS REFORMATED	800 BPI				COLOR (-) B & W (-)
IBM 360/65 & IBM 370/145 REMOTE TERMINAL	DIGITAL TAPES	9 TRACK 800 BPI	LARSYS	PATTERN RECOGNITION	PAPER PRINTOUT	-

Table 2.

EQUIPMENTS	IGC REMOTE SENSING LABORATORY/PHOTOGRAPHIC FACILITY								
	INPUT				PROCESS	OUTPUT			
	PRODUCT	FORMAT	SCALE	IMAGE		PRODUCT	FORMAT	SCALE	IMAGE
DURST COLOR ENLARGER	CUT FILM	MAXIMUM 13x18cms	LANDSAT 70 mm	B&W (+)	COLOR COMPOSITE GENERATION	CIBACHROME PAPER	MAXIMUM 20"x20"	LANDSAT MAXIMUM 1:500.000	COLOR(+)
				B&W (-)	ENLARGEMENT	AGFA PAPER			B&W (+)
				COLOR(+)		CIBACHROME PAPER			COLOR(+)
			AERIAL ANY	COLOR(-)		KODAK PAPER		AERIAL ANY	COLOR(+)

Table 3.

EQUIPMENT	IGC REMOTE SENSING LABORATORY/FIELD TEST FACILITY			
	ENVIRONMENTAL MEASUREMENT	PARAMETER	RANGE	OUTPUT
MOTOR BOAT	WATER	TRANSPORTATION	-	-
TRUCK	LAND	TRANSPORTATION	-	-
CONTACT THERMOMETER	LAND WATER/AIR	SURFACE TEMPERATURE	-10° + 60°	REGISTER
SOIL THERMOMETER	LAND	TEMPERATURE 50 cms DEPTH	-10° + 65°	INDICATOR
WATER THERMOMETER	WATER	TEMPERATURE UNTIL 15m DEPTH	-10° + 60°	INDICATOR
pH-METER	WATER LAND	ACIDITY	0 - 14	INDICATOR
AUTOMATIC METEOROLOGICAL STATION	AIR	WIND SPEED WIND DIRECTION RELATIVE HUMIDITY TEMPERATURE	0.75mph 0° - 360° 0 - 100% -35° + 49°C	REGISTER
SPECTROPHOTOMETER	WATER	COLOR TURBIDITY SUSPENDED SOLIDS 57 TESTS ON LABORATORY	VARIABLE	INDICATOR
SPECTRORADIOMETER	LAND WATER	PERCENT DIRECTIONAL REFLECTANCE	400 nm 1350 nm WAVELENGTH	COMPUTER PRINTOUT
CONDUCTIVITY METER	WATER LAND	SALINITY CONDUCTIVITY	0 - 100	INDICATOR
NOT DECIDED	LAND	HUMIDITY	0 - 100%	INDICATOR

Table 4.

EQUIPMENTS	IGC REMOTE SENSING LABORATORY/LIBRARY FACILITY	
	PRODUCTS	FORMAT
MICROFICHE READER	NTIS MICROFICHES	4" x 5"
MICROFILM READER	LANDSAT MICROFILMS	16 mm
BIBLIOGRAPHY	BOOKS REVIEWS NEWSLETTERS	ANY
ARCHIVE	IMAGES	ANY
AUDIOVISUAL	FILMS	ANY

Table 5.

contain good quality LANDSAT images taken over Madrid last September and January.

ERIPS program has the following capabilities:

- Pattern Recognition
- Image Registration
- Load
- Image Composition
- Image Manipulation and display
- Delog

Research is been done for selection of the optimum parameters (gain and standard deviation) to obtain, through the DICOMED film recorder, good images with enhanced contrasts. Another point of research consists on the selection of four channels of LANDSAT data obtained as a linear combination of bands 4, 5, 6 and 7. This is done because correlation of the information is very strong in all four bands MSS.

The DICOMED D-47 film recorder has recently been installed at the computer facility of the IGC, interfaced to PDP 11/45 computer. Experimental work is been done with some LANDSAT-1 CCT's, in order to obtain the best color balance and tape format for recording. Tests have been run checking the best type of film to use in each application. At the moment, photographic films used are:

- Kodak Plus-X Pan 4147 (-)
- Kodak Ektachrome 6115 (+)
- Kodak Vericolor II 4107 (-)

Output images from the CRT are in 70 mm format with a resolution matrix of 2340x1480 LANDSAT pixels for most appli-

cations. The ultra-high resolution option (4096x4096) is available (figure 1).

III. ACCOMPLISHMENTS

All working groups in this multidisciplinary project received enlarged paper prints, at scale 1:500.000 in black and white, by the end of January. At the moment, the main activity of research has concentrated on recognition and identification of natural phenomena in the images by photointerpretation techniques.

Repetitive coverage of LANDSAT-2 existing over Central Spain allows the investigation of the following aspects on forestry applications:

- Recognition of forest disease by 10 different insects causing strong damage on different species; mainly conifers. Inventory of damaged areas has been done already by ICONA (Instituto para la Conservación de la Naturaleza), and work will be oriented towards selection of optimum spectral bands and time coverage for recognition of damages by each specie.
- Identification of forest fires three years old with indication of minimum sizes detectable on LANDSAT-2 images, and evaluation of their vegetative coverage. Inventory has also been done by ICONA and a short field work is required for this purpose.
- Identification of mixed forests existing in Central Spain. Inventory does not exist and this work will probably require some intensive field research for quantitative measurement of dominant species.

From the cartographic point of view, a non controlled



Figure 1: DICOMED D-47 film recorder

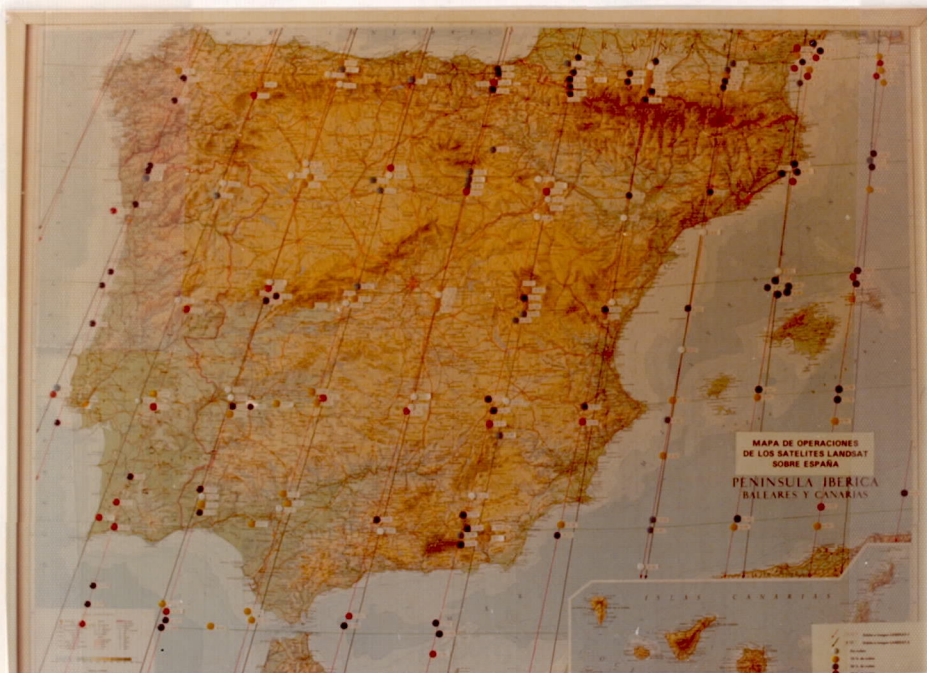


Figure 2: Existing LANDSAT coverage over Spain

mosaic will be done covering Spain in band 7 at scale 1:1000.000. Figure 2 shows existing coverage by LANDSAT-1&2 satellites.

There are two main cartographic objectives to attend in this project. One concerns the use of a Zoom Transfer Scope for updating provincial charts at scale 1:200.000. One of the most recent cartographic publications of the IGC is the Map of the Province of Madrid at that scale. Updating will require photointerpretation work on LANDSAT-2 images for identification of communications network, drainage patterns, forest species, reservoir locations and urban sites.

The other objective deals with the development of techniques, in laboratory and field, for delineation of land use maps. Because the limited experience existing in Spain on this field, a level I classification is considered appropriate. The Photogrammetric Division of the IGC will receive a Zoom Transfer Scope by the end of March 1976.

IV. SIGNIFICANT RESULTS

None of the working groups has submitted Quarterly Reports with results. However, all the participants have received enlarged LANDSAT-2 images by the end of January and some results will be announced on the Second Quarterly Report.

V. PUBLICATIONS

Since September 1975 a semimontly Teledetection Newsletter in published. It includes continuous references to development of this project, images received from NASA, remote sensing equipments available in Spain, publications, congress, etc.

Instituto Geográfico y Catastral has at present a publication on print entitled "La Teledetección y sus Aplicaciones Sociales".

VI. PROBLEMS

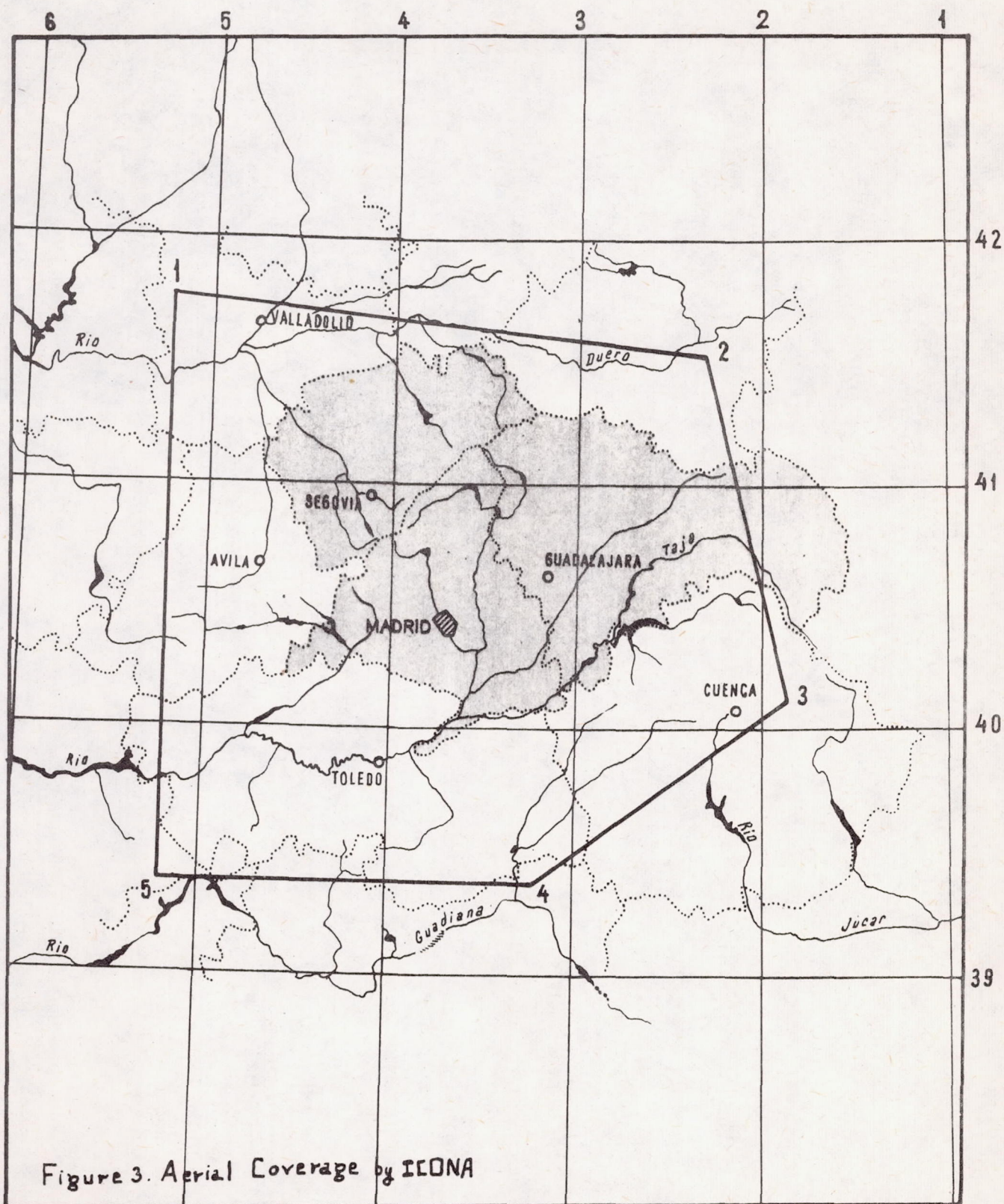
This project was started upon receipt of the first LANDSAT-2 images over Spain from NASA in September 1975.

In the future, new images processed by Fucino Receiving Station in Italy could not meet the requirements for photointerpretation work. If so, most of the participants in this multidisciplinary project should be affected because their main activity is concerned with photointerpretation techniques.

VII. DATA QUALITY AND DELIVERY

LANDSAT-2 images over Central Spain received from NASA are the following:

<u>no. imagen</u>	<u>fecha</u>	<u>Coordenadas punto nadiral</u>	<u>% nubes</u>
E-2169-10143	10-7-75	W002-45/N41-46	10
E-2169-10145	10-7-75	W003-15/N40-20	10
E-2170-10204	11-7-75	W004-41/N40-21	10
E-2171-10255	12-7-75	W005-37/N41-45	0
E-2171-10262	12-7-75	W006-07/N40-19	0
E-2187-10141	28-7-75	W002-40/N41-49	10
E-2187-10143	28-7-75	W002-12/N40-23	0
E-2187-10150	28-7-75	W003-38/N38-57	0
E-2223-10135	2-9-75	W003-08/N40-16	0
E-2223-10141	2-9-75	W003-37/N38-51	0
E-2188-10195	29-7-75	W004-30/N42-00	0
E-2188-10201	29-7-75	W005-00/N40-30	10
E-2189-10253	30-7-75	W006-00/N41-00	10
E-2240-10000	19-9-75	W002-00/N40-30	0
E-2240-10073	19-9-75	W001-30/N42-00	0



point no.	LATITUDE					LONGITUDE						
	DEG	MIN	DIR			DEG	MIN	DIR				
1	4	1	5	6	N	0	0	5	1	1	W	
2	4	1	3	2	N	0	0	2	1	8	W	
3	4	0	0	8	N	0	0	1	5	2	W	
4	3	9	2	3	N	0	0	3	1	2	W	
5	3	9	2	2	N	0	0	5	1	3	W	

Escala 1:2.500.000
0 100 Km.

Each image is available in the four bands of MSS sensor.

Test sites have been flown recently by Aerial companies under contract with ICONA. Photograms obtained, at scale 1:20000, will be used for correlation of data with ground truth observations. Figure 3 represents area covered by the flights and location of the area of this project.

The quality of 70 mm negative films received through EROS Data Center is not good for enlargement to paper print. In most of the originals a density correction has been necessary. Registration crosses do not adjust exactly in bands 4,5&7 and this creates a problem for color composite generation on the color additive viewer.

Quality of black&white paper prints received at scale 1:1.000.000 is good for photointerpretation purposes.

Reception of images from EROS Data Center is very satisfactory through our distribution organization: Air Attachee of Spanish Embassy in Washington and CONIE (Comisión Nacional de Investigación del Espacio). None delay was observed on delivery to Instituto Geográfico y Catastral.

VIII. RECOMMENDATIONS

Instituto Geográfico y Catastral would appreciate knowing future observation dates over Central Spain with LANDSAT-2 satellite. This is important in order to obtain data of ground truth in the test sites, between 9.00 and 11.00 local solar time, the same day that LANDSAT-2 makes the observation. Because a spectroradiometer is available for field work, percent directional reflectance curves could be obtained simultaneously to the LANDSAT-2 orbital pass.

IX. CONCLUSIONS

This project offers excellent possibilities of investigation for all participant working groups. Information supplied by LANDSAT-2 served as a new tool for several scientific activities, and has allowed the development of a new working methodology in each of the participant organizations.

LANDSAT-2 multispectral information brings a new point of view to the earth sciences, which will be most useful for the national community.

Detailed results of this investigation provided by each participant organizations will be published in the Second Quarterly Report.